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Magnetically Coupled Corrosion Gauge (Prototype Design)

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3013 Pressurization and Corrosion

"Although the materials [in the 3013] are stabilized prior to packaging in order to reduce the moisture content to below 0.5 weight percent and reduce material surface area, the 94-1 Program has identified two potential failure mechanisms of the 3013 container associated with moisture and impurities: **pressurization** due to gas generation and **corrosion** associated with impurities (specifically chlorides and fluorides) in the plutonium oxides."

- 3013 Integrated Surveillance Program (ISP) document, LA-UR-00-3246

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Magnetically Coupled Gauges (Pressure "Puck" and Corrosion "Puck")

- Utilize magnetic "transparency" of 300-series stainless steel
- Current designs are adaptable to many configurations
- Comply with DOE-STD-3013-2000 for materials
- No power required for in-can sensor
- 50-year design life
- No modifications of storage or transportation containers (9975, SAFKEG) required
- Readouts can be designed into "Smart Pallets" for reading Pressure Pucks or Corrosion Pucks in real-time

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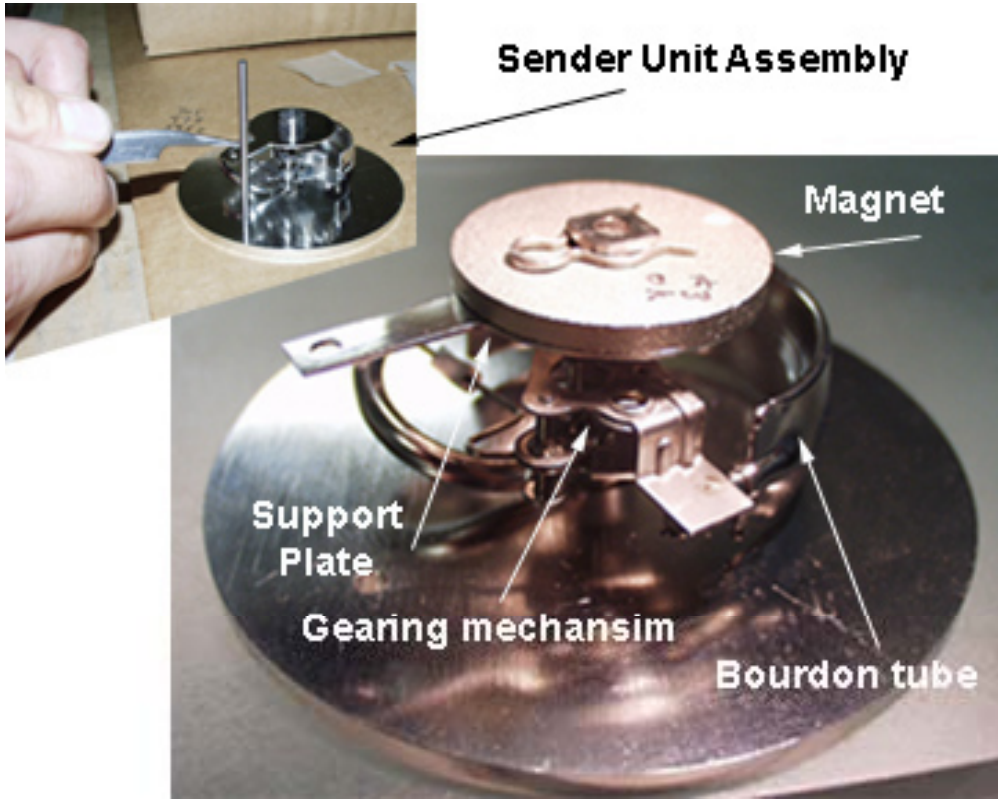
Magnetically Coupled Pressure Gauge (MCPG)
"Pressure Puck"



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Magnetically Coupled Corrosion Gauge (MCCG)
"Corrosion Puck"

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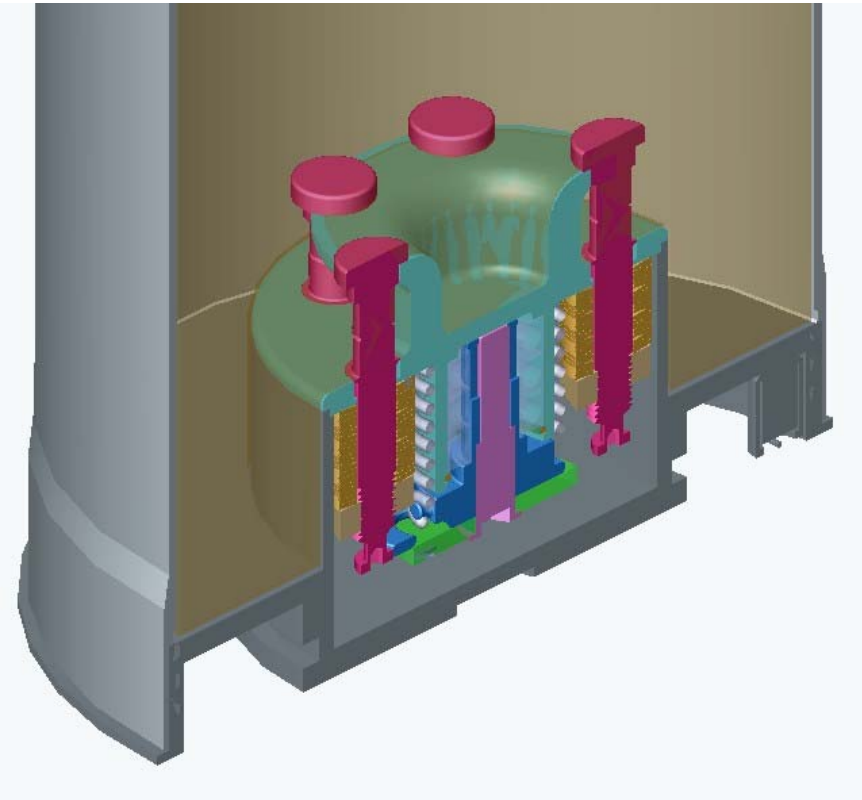
MCCG "Corrosion Puck" Overview



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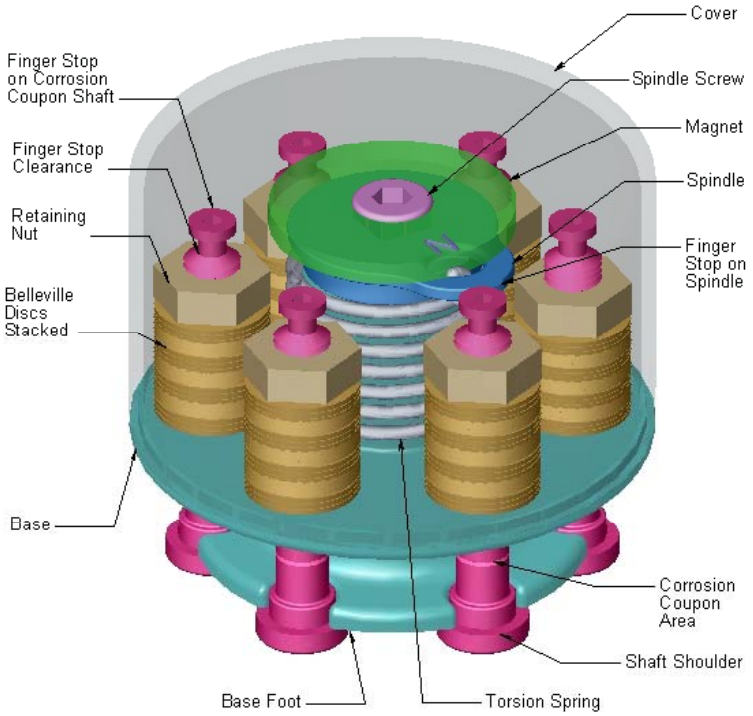
MCCG Prototype Design



Corrosion Puck Solid 3-D Model

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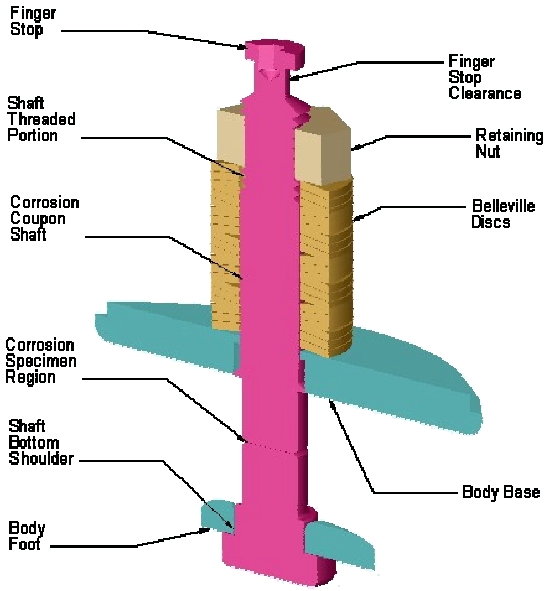
MCCG Prototype Design



Corrosion Coupon Subassembly

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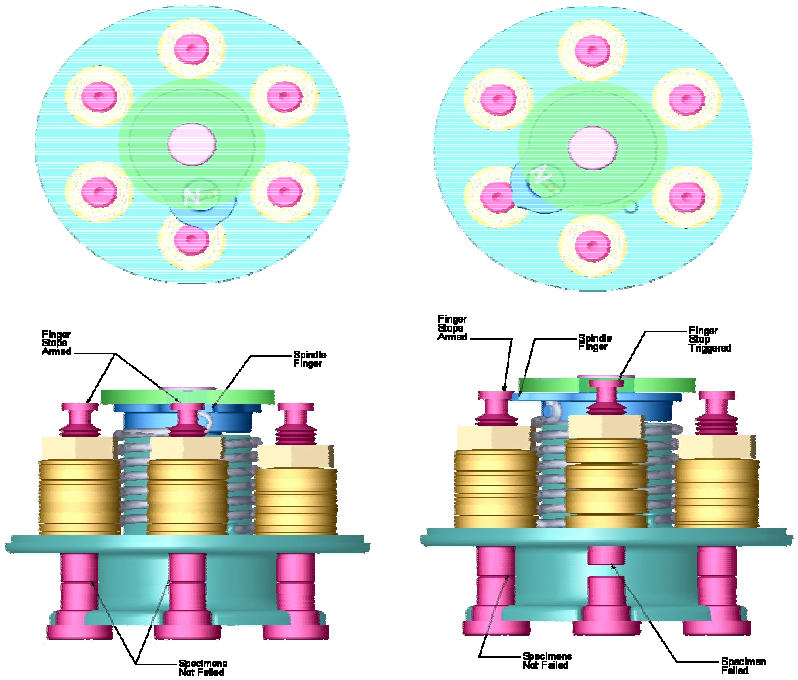
MCCG Prototype Design



(a) All Specimens "Armed" (b) First Specimen Failed

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MCCG Prototype Design

- **Belleville Springs (Cupped Washers) Provide Stress To Coupon Specimen Region**
- **Applied Stress Controllable By Thickness and Number Of Washers**
- **Coupons Can Be "Staged" To *Measure* Corrosion Rates**

Table I. Specimen diameter required for specified stress at 430# force

Stress (psi)	30,000	25,000	20,000	15,000	10,000
Diameter (in.)	0.135	0.148	0.165	0.191	0.234

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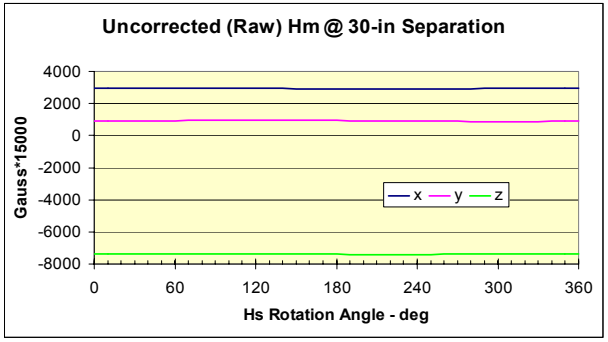
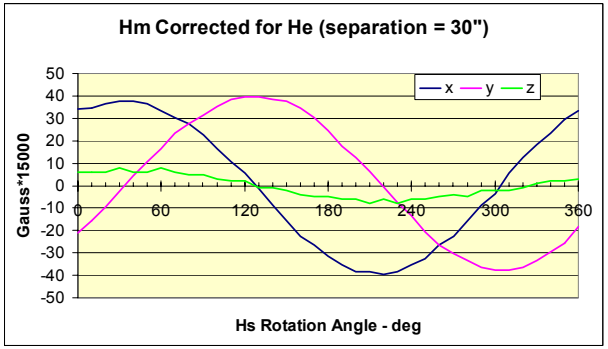
Readout Using Differential Magnetometer (Gradiometer) Allows Long "Reach"



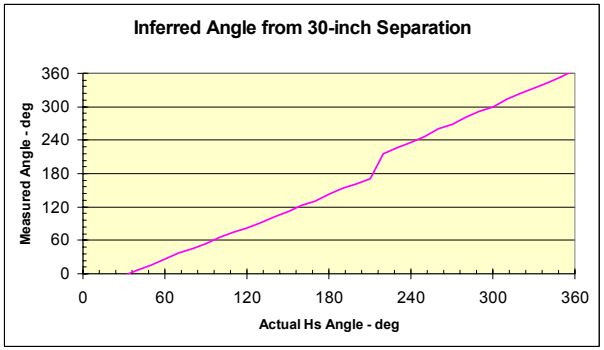
$\vec{H}_e$



Z

Magnet, $\vec{H}_s$

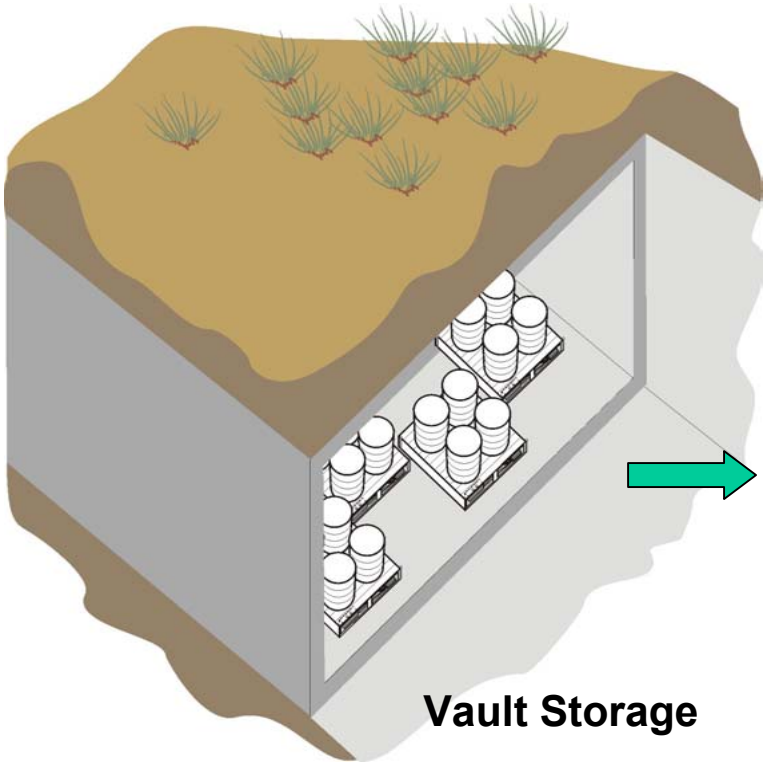
Magnetometer, $\vec{H}_m$

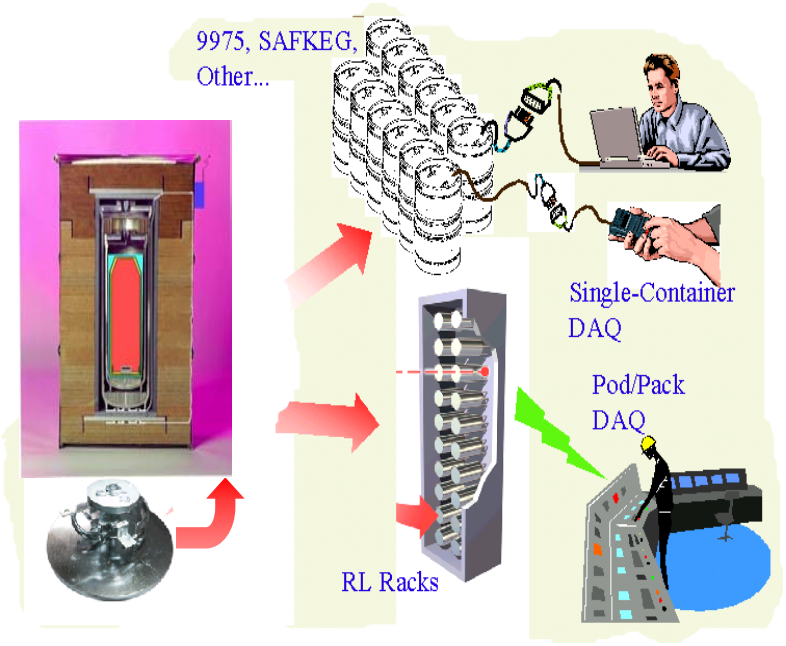


$\vec{H}_m = \vec{H}_s + \vec{H}_c$ **Measured**

$\vec{H}_s = \vec{H}_m + \vec{H}_c$ **Corrected**

MCCG/MCPG Provides Surveillance and Monitoring





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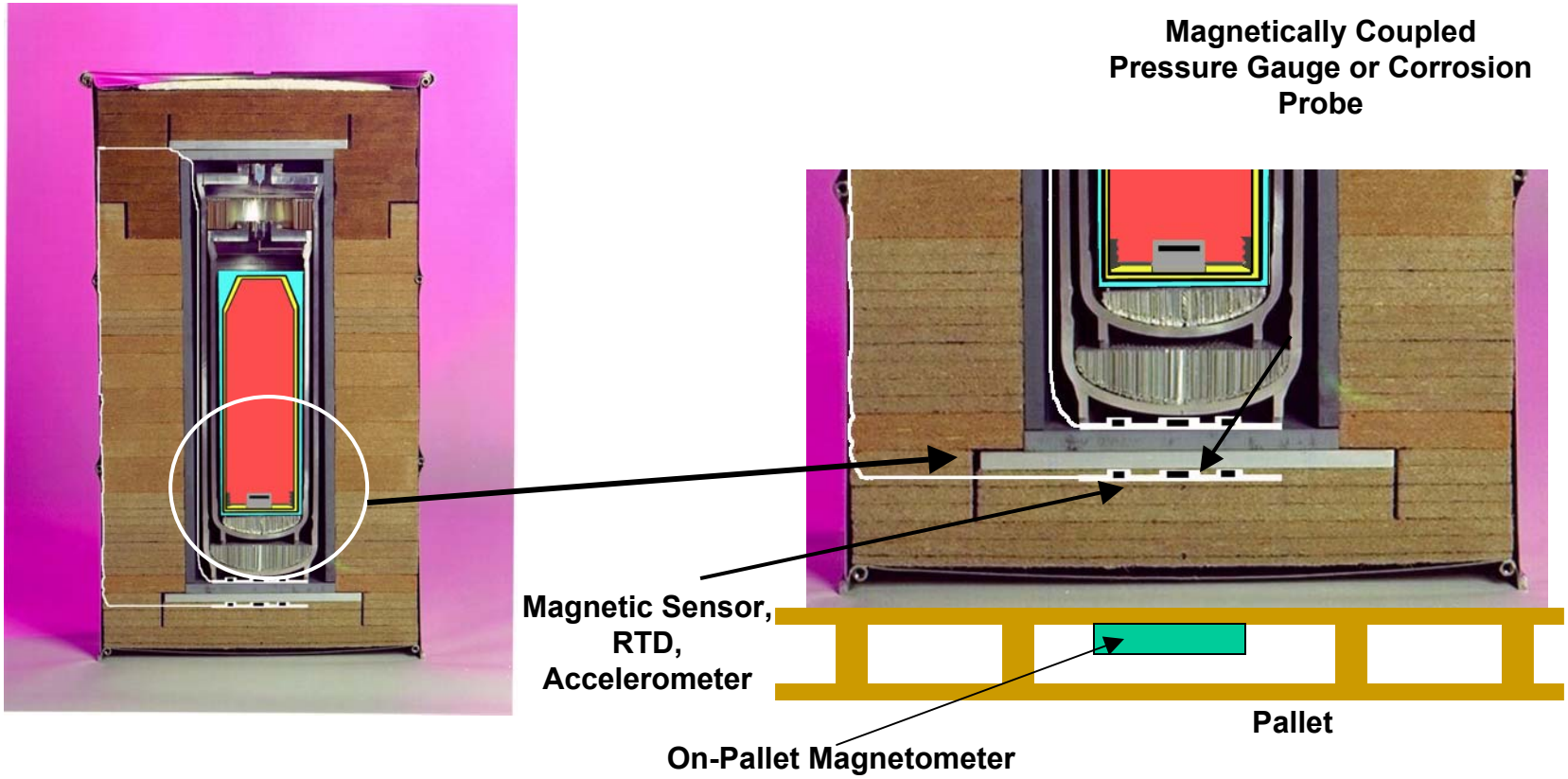
In-Can or "Smart Pallet" Readouts Provide Flexibility



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Summary

- MCPG and MCCG Directly Address Concerns Regarding Possible Failure Mechanisms Of Pu Containers
- MCCG/MCPG Offer Potential For Non-Intrusive, Real-Time Measurement Of Corrosion And Pressure In DOE Cans
- Designs Fully Compatible With 3013, 9975, SAFKEG, ...
- All Materials/Compatibility Issues Resolved
- Gradiometer Offers Potential For A Pallet-Mounted Readout
- Installation Options Provide For A Variety of Uses
- 100 MCPG “Pressure Pucks” Delivered To RL October 2002